REPORT OF THE COMMITTEE ON METEOROLOGY.

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The science of meteorology is in its formative stages. It has not advanced to the plane of an exact science. While prognostications of the weather and signs and portents to foretell climatic changes are as old as the race itself, the great mass of these have no scientific base for a foundation, and many of them are merely old-time traditions and superstitions.

The organization of the signal service bureau has done much toward the formation of a science of meteorology. The data gathered by that bureau will in the course of time be crystallized into a science.

The year 1889 may be classed among the flood years. It has been characterized by an excessive precipitation throughout the central belt of the northern hemisphere. Floods have occurred in the United States, in Europe and Asia. In this report we shall confine ourselves to observations on atmospheric phenomena of Southern California.

The year 1889 was an exceptional one in several respects. First, rain fell every month except June and September; second, a very small precipitation during the usually rainy months of January and February (precipitation for January, .25 in., February, .92 in.); third, a heavy rainfall in March (precipitation, 6.48 in.); fourth, unusually heavy rain storms in October and December, the rainfall for October and December being in excess of any recorded rainfall for those months since a record has been kept.

The record shows that the maximum mean temperature was reached in August, the minimum in January. Number of days in which rain fell, 62; clear, 258.

A marked feature of the October storm, and to a certain extent of the storms of the season so far, was the unequal distribution of the rainfall. The report of the signal service division of the Pacific gives the following at different stations in Southern California:

PLACE.	RAINFALL, OCTOBER, 1889.	NORMAL OR AVERAGE SEASON RAINFALL FOR OCTOBER.
Santa Barbara,	10.57 inches.	0.47 inches.
Los Angeles,	7.00 "	0.46 "
Anaheim,	2.31 "	0.36 "
Santa Ana,	1.91 "	not given.
San Diego,	2.10 "	0.41 "
Colton,	1.59 "	0.28 "

Thus we find that while the average season rainfall for October throughout a period of ten years, from 1878 to 1888, in Santa Barbara and Los Angeles varies only 1-100 of an inch, the variation in the October storm was 3.57 inches. The difference between San Diego and Los Angeles was 4.90 inches; between San Diego and Santa Barbara, 8.47 inches; difference in the average October rainfall of San Diego and these points is 5-100 and 6-100, respectively. Santa Ana, in an air line thirty miles southeasterly of Los Angeles, reports 5.09 inches less rain; Colton, fifty miles east, 5.41 inches less.

The mean monthly temperature at all the Pacific stations for the months of October, November and the first half of December was above the average, the month of October being unusually warm. The mean temperatures at Los Angeles and San Diego were for

	OCTOBER.	NOVEMBER.	DECEMBER.
At Los Angeles,	66°	61°	55°
At San Diego,	65	62	58

Another peculiar feature of the rainfall of the season up to the close of the second December storm, December 15, was the comparatively small precipitation on and in the vicinity of the higher mountain ranges. San Bernardino, distant about twelve miles from the highest mountain of Southern California, Mount San Bernardino (over 11,000 feet high) up to December 14 reported a rainfall of 9.43 inches; Pomona, at the same date, 11.75 inches; Los Angeles, 16.78 inches; Santa Monica, about the same as Los Angeles.

Up to the 21st of December the storms were coast storms. This is evidenced by the limited rise of the rivers. December 12 and 13, in Los Angeles, 4.30 inches fell in twenty-four hours, a greater fall than that of the 24th of December, which flooded a portion of the city and country. That this heavy fall did not cause a disastrous flood was due to the limited precipitation in the mountain districts.

The common theory is that high mountains act as condensers of moisture; consequently the precipitation on our higher mountain ranges and their foothills should greatly exceed that of the valleys. Generally speaking the theory is true, but there are very many exceptions and limitations to it. In my opinion, the northeast or polar wind current is by far the larger factor in condensation of moisture on our coast, the mountain ranges acting more as elevators of the current than as condensers. Wherever there exists a considerable elevation, either a mountain chain or a high range of hills, lying transversely or at right angles to this current, all places situated near the southwest base of such will have a heavy rainfall. Instance: Pasadena, Glendale, Los Angeles, Santa Monica and Santa Barbara, in Southern California; San Francisco, Saucilito, San Rafael and Napa, in Central California;

Sisson, Redding, Yreka and Shasta, in Northern California. The latter place, Shasta, reports a rainfall of 62.56 inches up to December 27. The transverse mountain chains lift or deflect the polar current into the upper air strata, where it performs the office of condensation without acting as an absorber of moisture. These transverse ranges are rain divides. Wherever a low pass in the mountains allows the polar or northeast current to drop into the lower air stratas, the precipitation will be decreased. Instance: San Bernardino, Colton, Riverside, Anaheim and Santa Ana in Southern California. The three first named have a greater elevation than Los Angeles. The rainfall at Riverside up to December 27 measured only 9.36 inches; up to the same date at Los Angeles, 25.62 inches; at Anaheim to the same date, 13.56 inches. The northeast winds from the Cajon and San Gorgonio passes focus upon Riverside and Colton, consequently these places record comparatively small season rainfalls, that of Riverside in 1882-83 being only 2.94 inches; Los Angeles for the same season, 12.11 inches.

There is often a very marked difference in the amount of rainfall recorded by gauges at stations close to each other. The following reports are from three sources—signal station southwest corner of First and Spring street (No. 1), Germain Fruit Company, Alameda street near Macy (No. 2), and the Southern Pacific depot (No. 3), all taken by standard gauges. These records are up to December 26:

No. 1, 24.72 inches; No. 2, 22.46 inches; No. 3, 25.62 inches.

The difference between the lowest and highest record is 3.16 inches. The extreme distance apart is less than a mile. The elevations from the ground are as follows: No. 1, 66 feet; No. 2, 20 feet; No. 3, 10 feet. The distance from the ground at which the gauge is placed may account in part for the difference but not entirely. Variable or eccentric wind currents of different temperature undoubtedly increase or decrease precipitation accordingly as they are cold or warm.

An approaching heavy rain storm is first signaled from points on the western coast of Washington, Oregon or Northern California. Moving southeasterly, it usually reaches us in from thirty to fifty hours after it strikes the northwestern part of the coast.

The October storm was reported in Washington and Northern Oregon on the 6th, Northern and Central California on the 7th, and reached us on the 8th. Most of the December storms entered the coast in Northern California. The storm center being so much further south than usual no doubt accounts for the violence of our December rains and the unusual precipitation. The December rainfall for Washington and Oregon is below the average for that month. There is seemingly a meteorological paradox in connection with our rain storms which, so far as I know, none of our local climatologists have made a note of. All

our heavy rain storms travel from northwest to southeast, moving from the points where they strike the northwest coast southeasterly through from six to ten degrees of longitude. Skirting the western flanks of the Cascades and Sierra Nevada, occasionally crossing these mountain barriers, they expend their force or leave the coast from fifty to one hundred and fifty miles south of San Diego.

The signal service reports rain in Oregon or Northern California, and if the storm is a heavy one, in due time it reaches us. Moving down the coast from the northwest it reaches us from the southeast, rather a paradoxical performance. Our climatologists tell us that the return trade winds, bringing with them immense volumes of moisture gathered from that other paradox, the Kuro Siwo, deposit it in our valleys as rain and on our mountains as snow. The return trades are southwest winds, and every one knows or ought to know that in our part of the state the winds that bring us rain blow from the southeast. One California meteorologist of some standing tells us that the great mountain ranges on the western coast of Mexico change the direction of the return trades, force them through the long narrow Gulf of California and along the Pacific coast, and they pass over the state as southeast winds. These winds, he tells us, are warm and moist when they reach us. Let us see where they get their moisture. The northeast trade winds blow from about 30° north latitude to the equator. The return trades passing over them as an upper current become surface winds beyond the calms of Cancer, say in latitude 31° north. The Gulf of California heads in latitude 31° north. Now if these return trades went skirting along the high mountain ranges of Mexico, dropping to the surface in the desert regions about the head of the gulf, then blowing from the southeast across the Colorado desert and over the San Jacinto range, it is my opinion that they would reach us about as dry and unsatisfactory as this climatologist's theory.

It is now a generally accepted theory that all violent storms are great whirlwinds called cyclonic areas, in which the wind blows in circuits around an axis. This axis is the storm center and the area of low barometer. The circuit of motion is spirally inward and upward in ever narrowing circles, gradually ascending as they approach the center. These areas on our coast originate or move with the Japan current upon the Oregon or Washington coast. Striking the high Cascade range, which parallels the coast, they are deflected southeastward. Flattened by the mountain barrier, they assume an oval form with the longer axis in the same direction as that of the longer axis of the cyclonic disturbance, the broad part of this in the north and tapering to the south. North of Cape Mendocino the rain wind blows from the southwest. South of that cape, where the coast bends to the southeast, the

rain wind is a southerly wind, and south of Point Concepcion, where the coast line bends still more rapidly toward the east, the rain wind is from the southeast. Placing your back to the rain wind, the area of low barometer and the storm center will always be on your left.

Is our climate changing? With every abnormal freak of the weather some amateur meteorologist rushes into print to inform the world that the climate of Southern California is changing. We are positively assured that the dreaded dry years are things of the past, that the planting of trees, the cultivation of the soil, increase of population, building of railroads, etc., have increased and are increasing our rainfall every year. If any one will take the time and trouble to search through the files of our California papers for twenty years or more back, he will find the timber theory of rain production advanced every wet year and ignored every dry year.

If some arboriculturist could devise a plan for planting our foothills and mountain sides with forests of giant sequoia and lofty sugar pine full grown and could keep them growing, possibly during a rain storm the precipitation on the mountain sides might be slightly increased. But that a few orange groves and deciduous fruit orchards and a few scattering clumps of gum trees should change the climatic conditions of the Pacific slope throughout a distance of 1,500 or 2,000 miles is drawing a very big conclusion from a very small premise.

It is a well-known fact to the older residents that during the dry seasons of 1863–64 there was at least 50 per cent. more timber on the foothills, in the canyons and on the mountain sides of Southern California than there is now. Live oak, white oak, mountain ash and lining the river courses were dense growths of willows. Possibly the low growing orange, apple and peach are better condensers of moisture than the loftier sycamore and oak.

If, as it is claimed, the ice line of the frigid zone is moving southward, in the course of time the Japan current will be deflected more to the southward and the area of cyclonic disturbance will move southward with it, and our climate will change slowly, but so very slowly that the change will not disturb any of the present residents of Southern California.